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POLY SYSTEMS PTY LTD

AUSTRALIA
Patents Act 1990

PROVISIONAL SPECIFICATION FOR THE INVENTION ENTITLED:

"FASTENER DRIVING TOOL"

The invention is described in the following statement:-

FASTENER DRIVING TOOL

TECHNICAL FIELD

The present invention relates to an internal combustion fastener driving tool.

SUMMARY OF INVENTION

A fastener driving tool comprising: a tool nose through which a fastener is fired; loading means for introducing said fastener into said tool nose; said fastener being adapted to be propelled by a gas combustion mechanism, wherein said gas combustion mechanism comprises a first priming cylinder having a first piston and an air intake fluidally connected via a first valve means to a second delivery cylinder having a second piston, said first priming cylinder fluidally connected to a fuel gas reservoir via a second valve means, said first priming cylinder adapted to receive fuel gas from said fuel gas reservoir and air through said air intake thereby forming an air/ fuel gas mixture therein, said first piston adapted to compress said air/fuel gas mixture and transfer said air/fuel gas mixture to said second delivery cylinder via said first valve means, said air/fuel mixture ignited therein and thereby urging said second piston towards said fastener and propelling the same away from said tool nose.

BRIEF DESCRIPTION OF DRAWINGS

Fig. 2 is a cross-sectional schematic view of the nail gun of Fig 1.

Fig. 3 is a cut away end view of the nail gun of Fig 1.

Fig. 4 is an enlarged view of the gas combustion mechanism shown in Fig 2.

Fig. 5 is an enlarged view of the gas combustion mechanism shown in Fig 2, as air and fuel enter the priming cylinder.

Fig. 6 is an enlarged view of the gas combustion mechanism shown in Fig 2, as air/fuel mixture is compressed in the priming cylinder.

Fig. 7 is an enlarged view of the gas combustion mechanism shown in Fig 2, as air/fuel mixture is transferred from the priming cylinder to the driving cylinder.
Fig. 8 is an enlarged view of the gas combustion mechanism shown in Fig 2, as air/fuel mixture within the driving cylinder is compressed.

Fig. 9 is an enlarged view of the gas combustion mechanism shown in Fig 2, as the ignited air/fuel mixture displaces the piston within the driving cylinder towards the nail to be fired.

Fig. 10 is an enlarged view of the gas combustion mechanism shown in Fig 2, as the driver connected to the piston propels the nail and the gas begins to be exhausted from the driving cylinder.

Figs. 11 and 12 are enlarged views of the gas combustion mechanism shown in Fig 2, as piston is returned back up the driving cylinder and remaining exhaust gas is purged from the driving cylinder.

Fig. 13 is an enlarged view of the cycle wheel arrangement used to control the tool cycle.

Fig. 14 is an enlarged view of an alternative embodiment of the cycle wheel arrangement shown in Fig 13.

Figs. 15a and 15b are enlarged elevation and cutaway views of the fuel gas cartridges.

MODE OF CARRYING OUT INVENTION

Fig 2 depicts a combustion driven nail gun for firing nail fasteners. The nail gun comprises a priming cylinder A and a power driving cylinder B, housed within tool main main body casing 62. A tool support handle 7 having a pistol grip 5 extends from casing 62 and houses a fuel gas cartridge (reservoir) 3. A battery 1 housed within removable battery casing 2 is attached to support handle 7. A nail fastener cartridge (or magazine) 4 delivers nail fasteners 8 to tool nose (or barrel) 9.

The operation of the combustion nail gun will now be described. A user holds combustion driven nail gun by tool support handle 7 and pistol grip 5. The user's finger is placed on firing trigger 16. Primary micro trigger 15 is activated. Electronic central processing unit (CPU) 18 is alerted that the tool is in operation. CPU 18 switches circuit on to a priming cylinder drive having a cycle sensor wheel 21 and main power feed slip ring 66 as shown in Fig 13. Motor 35 is activated. Wheel 21 rotates causing first piston 24 to progress downward in priming cylinder A via connecting rod 23, crank pin 22 and bearing 34. A partial vacuum occurs above piston 24 in priming cylinder A causing transfer valve 32 to close and inlet valve 31 to open. Air is drawn into priming cylinder A through intake port 30. Fuel delivery striker segment 25 makes contact with pin 27 opening gas valve 26 in the head of gas cylinder 3 for a short duration. A given volume of atomised fuel is released from cylinder 3 and passes through gallery 28 to inlet port 30. Atomised fuel gas mixes with inward flowing air at intake port 30 through valve 31, filling priming cylinder A with a mixture of fuel, gas and air, see Fig 5. Piston 24 progresses back up priming cylinder A, and a pressure rise occurs closing valve 31, see Fig 6, and opening valve 32 transferring air/fuel mixture from priming cylinder A into driving cylinder B. Electro magnetic exhaust valves 42 and 45 are energised during the upward progression of piston 24 causing valve head 45 to open, allowing the inward flow of fuel/gas air mixture through valve 32 to purge residual exhaust gases from combustion space in cylinder B see fig 7. When 50% of the fuel/gas air mixture phase has taken place slip ring 67 disengages electro magnetic valve 42 causing valve 45 to close via a coil spring (not shown) and sealing exhaust port 43. Piston 24 progresses to the top of priming cylinder A transferring fuel/gas air mixture into combustion area of driving cylinder B. Slip ring 69 disengages power circuit to motor. CPU 18 switches circuit on to cooling fan motor 41. Tool is positioned and pressed onto work piece mechanism 61 is depressed alerting CPU 18 tool is safe to fire. CPU 18 switches circuit on to switch mechanism 17 allowing main firing trigger 16 to be fully depressed. Mechanism 17 alerts CPU 18 to activate ignitor 48. Fuel/air mixture in combustion area of drivung cylinder B ignites and an explosion occurs, a rapid rise of pressure occurs causing valve 32 to seal close, see Fig 8. Second piston 51 and driver 55 to progress down bore 54 of cylinder B. Driver 55 drives fastener 8 down tool nose 9 into the work piece. As piston 51 progresses

down cylinder B air under piston 51 escapes through exhaust port 60 and 12 (dr9). When piston 51 has travelled 90% of its travel the under side of piston 51 comes into contact with rubber bumper 58. Bumper 58 absorbs energy and slows the progression of piston 51. Exhaust port 60 is then uncovered allowing exhaust gases to escape from cylinder B into cavity 57 and then out through tool housing exhaust port 13. At the end of travel of piston 51, piston 51 makes contact with power driver cylinder piston end of stroke sensor 59. Sensor 59 alerts CPU 18 of pistons 51 position. CPU 18 energises electro magnetic exhaust valve 42 to open allowing exhaust gases to be expelled from the top of cylinder B through exhaust port 43 into cavity 57 and out through cavity 13 (dr10). Stored energy in bumper 58 returns piston 51 and driver 55 back up bore 54 in driving cylinder B. Remaining exhaust gases in driving cylinder B are purged through exhaust port 43. Air is allowed to be displaced to the underside of piston 51 in cylinder B through exhaust port 60 and 12 to prevent a partial vacuum inhibiting the return of piston 51 to top of bore 54 in cylinder B, see figs 11 and 12. CPU 18 has an electronic timing mechanism built-in to operate electro magnetic valve 42 and cooling fan 41. When piston 51 has reached the top of bore 54 of cylinder B, the CPU 18 switches the circuit to electro magnetic exhaust valve 42 off, allowing valve 45 to close. CPU 18 allows cooling fan 41 to remain active for a period of approximately 10 seconds in one-shot use only, or for continuous application the cooling fan 41 may remain active. A temperature sensor (not shown) in cavity 57 in communication with CPU 18 may be incorporated.

Fig 13 depicts a mechanical brake/limiting mechanism (not shown) to ensure that only one revolution of cycle wheel 21 per tool cycle is required.

Fig 14 is an alternate embodiment to the mechanical mechanism 21 of fig 13. In this alternate embodiment electronic crank angle mechanisms 70, 19a, stepper motor 35 and high-tension spark mechanisms maybe incorporated into and in communication with CPU 18.

Fig 15 high pressure liquid fuel cylinders containing for example methanol as a fuel medium and liquid/gaseous CO_2 as a pressurising medium as opposed to a conventional MAPP gas. Storing fuel in this manner typically at 850psi allows more efficient

atomisation of the fuel gas medium and combining with air mass in a combustion cylinder process more energy is extracted. Hydrogen may also be utilised as a fuel gas medium. Whilst the abovementioned embodiment of the present invention is described with reference to a nail gun for driving nails, it should be understood that the present invention in other not shown embodiments can be used to fire other fasteners.

Reference Numerals used herein

A ~ represents priming cylinder. B ~ represents power driving cylinder

1. Batteries (electrical)
2. Battery removable casing
3. Fuel gas cylinder
4. Fastener cartridge
5. Pistol grip
6. Battery retaining boss
7. Tool support handle
8. Fasteners
9. Tool nose (fastener guide)
10. Power cylinder base plate
11. Fastener driver support/guide
12. Base plate exhaust port
13. Tool housing exhaust port
14. Trigger guard
15. Primary micro trigger
16. Secondary main firing trigger
17. Secondary main firing trigger mechanism housing
18. CPU (electronic central process unit)
19. Priming cylinder cycle sensor. #19a crank angle sensor
20. Central cavity wall
21. Priming cylinder drive – cycle sensor wheel
22. Priming cylinder drive – cycle sensor wheel crank pin
23. Priming cylinder piston connecting rod
24. Priming cylinder piston
25. Fuel delivery striker segment
26. Affixing boss/fuel gas cylinder
27. Fuel delivery pin/mechanism
28. High pressure fuel delivery gallery
29. Cycle drive wheel belt
30. *A : Cylinder air/fuel intake port
31. *A : Cylinder intake valve
32. *A and *B: Cylinder transfer valve
33. *A : Cylinder piston ring
34. *A : Cylinder connecting rod bearing
35. *A : Cylinder cycle drive motor – or stepper motor

36. *A: Cylinder head retaining bolt
37. *A: Cylinder air intake/breather
38. Tool rear cover
39. Tool cooling fan blade
40. Tool cooling fan air intake and flow
41. Tool cooling fan motor
42. Electro magnetic exhaust valve body
43. Electro magnetic exhaust valve port
44. *B: Cylinder head retaining bolt
45. Electro magnetic exhaust valve head
46. Power driver cylinder piston retaining Colette
47. Power driver cylinder head
48. Ignitor
49. Power driver cylinder piston retainer
50. Power driver cylinder head cooling fins
51. Power driver cylinder piston
52. Power driver cylinder piston sealing rings
53. Power driver cylinder piston driver boss
54. Power driver cylinder
55. Power driver cylinder driver
56. Power driver cylinder body cooling fins
57. Power driver cylinder body cooling cavity
58. Power driver cylinder bumper
59. Power driver cylinder piston end of stroke sensor
60. Power driver cylinder exhaust port. 60a. Mask
61. Anti-skid immobiliser mechanism
62. Tool main body casing
63. *B: Lower cover – outer
64. *B: Lower base plate retainer bolts
65. Cycle sensor drive wheel bearing
66. Main power feed slip-ring
67. #42 valve slip ring
68. Ignitor circuit slip-ring
69. #35 motor slip-ring
70. Crank angle sensor disk
71. Methanol
72. CO_2 gas
73. CO_2 liquid

Bladder

Dated this 30th day of December 2003

POLY SYSTEMS PTY LTD

By:

HODGKINSON AND McINNES

Patent Attorneys for the Applicant

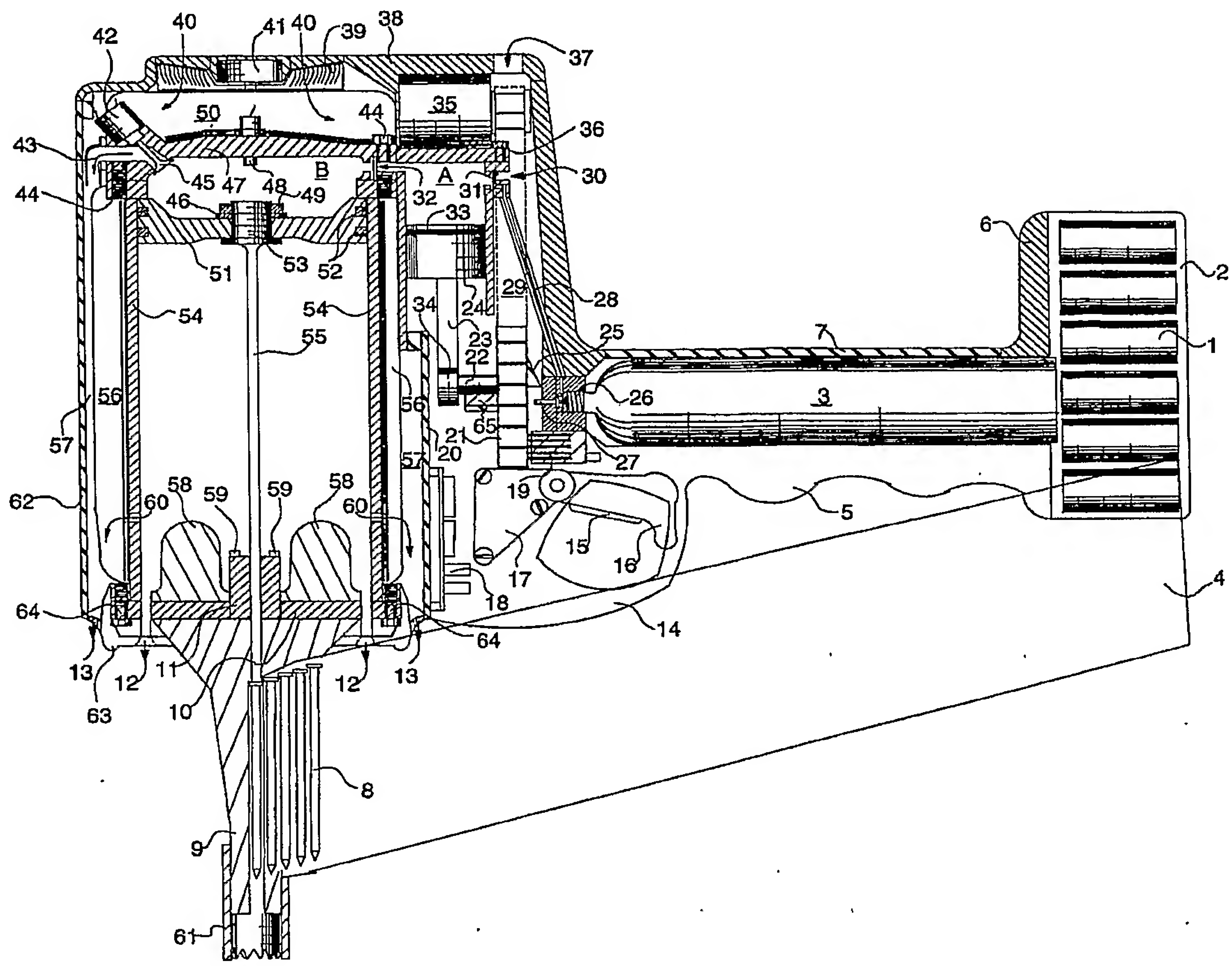

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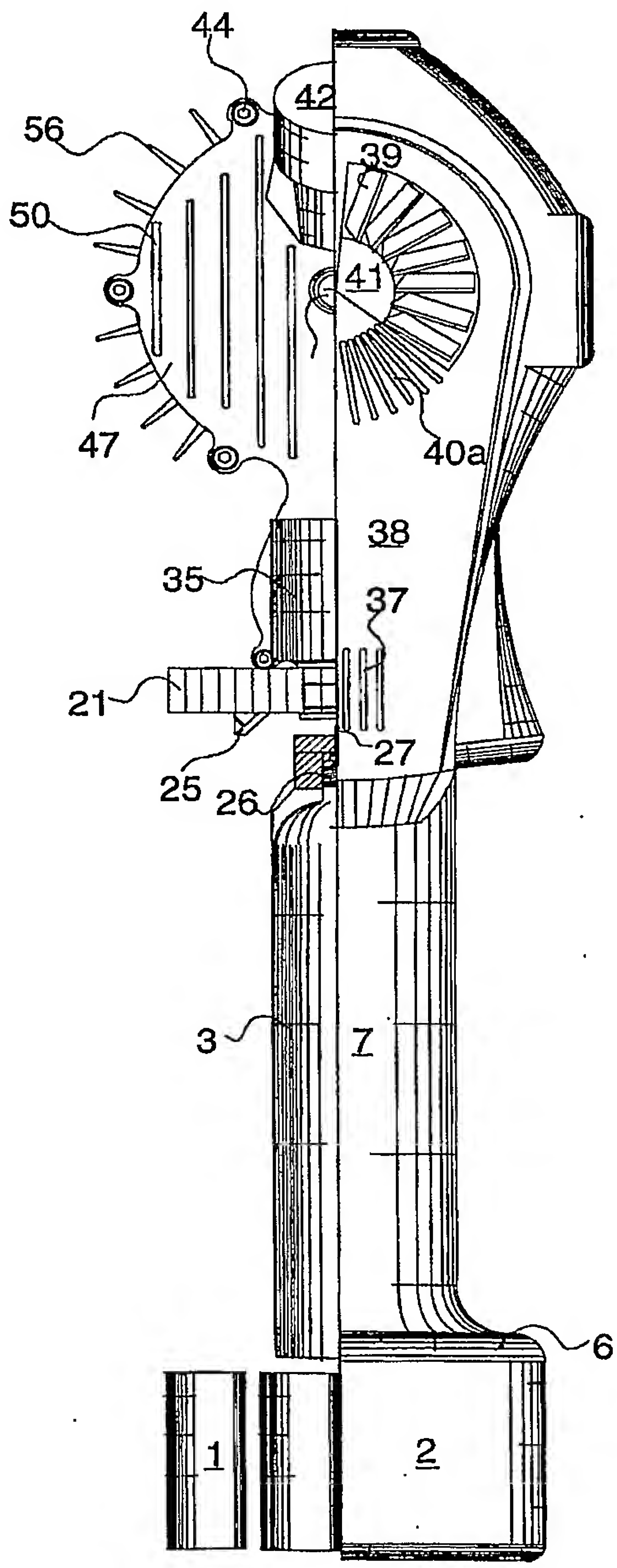
FIG. 2



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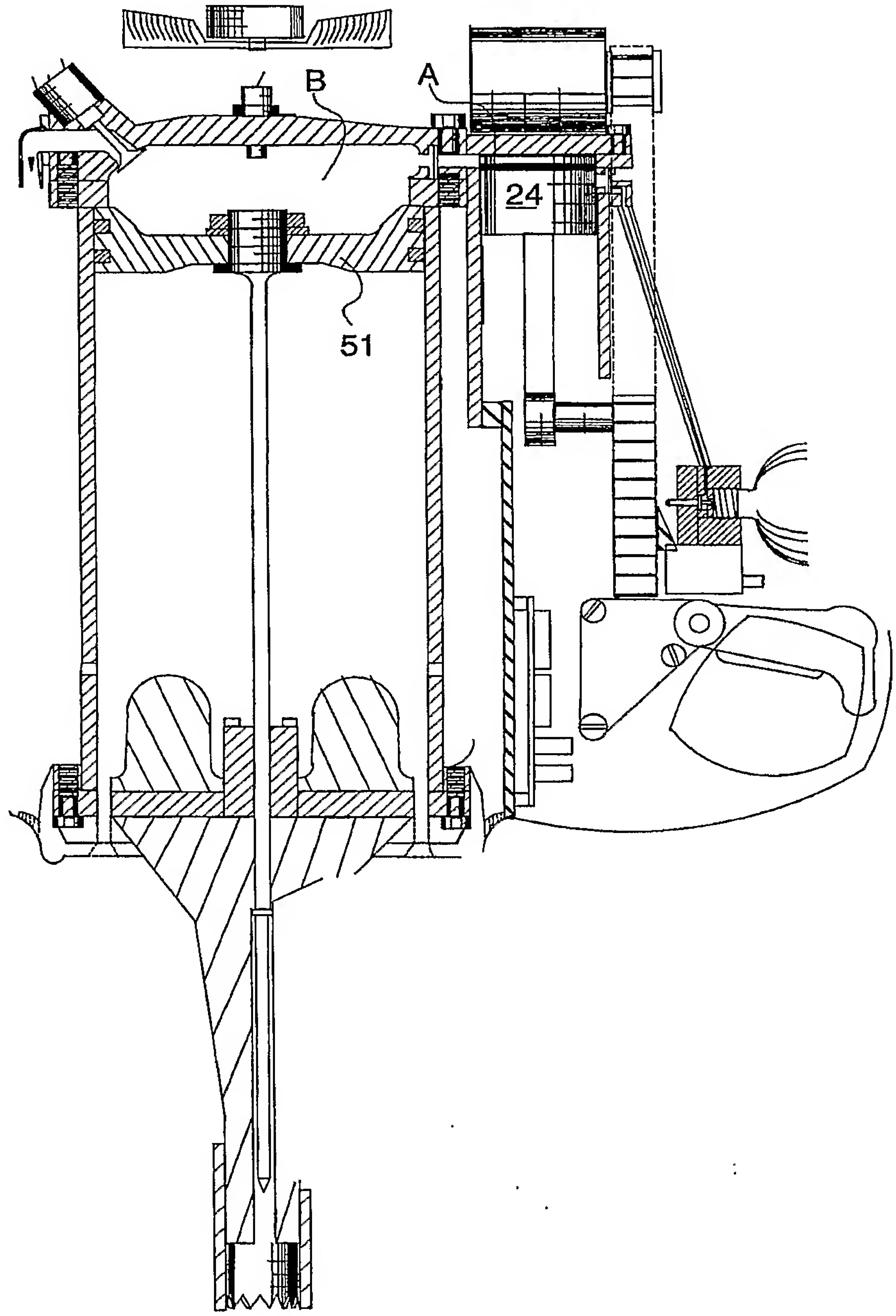

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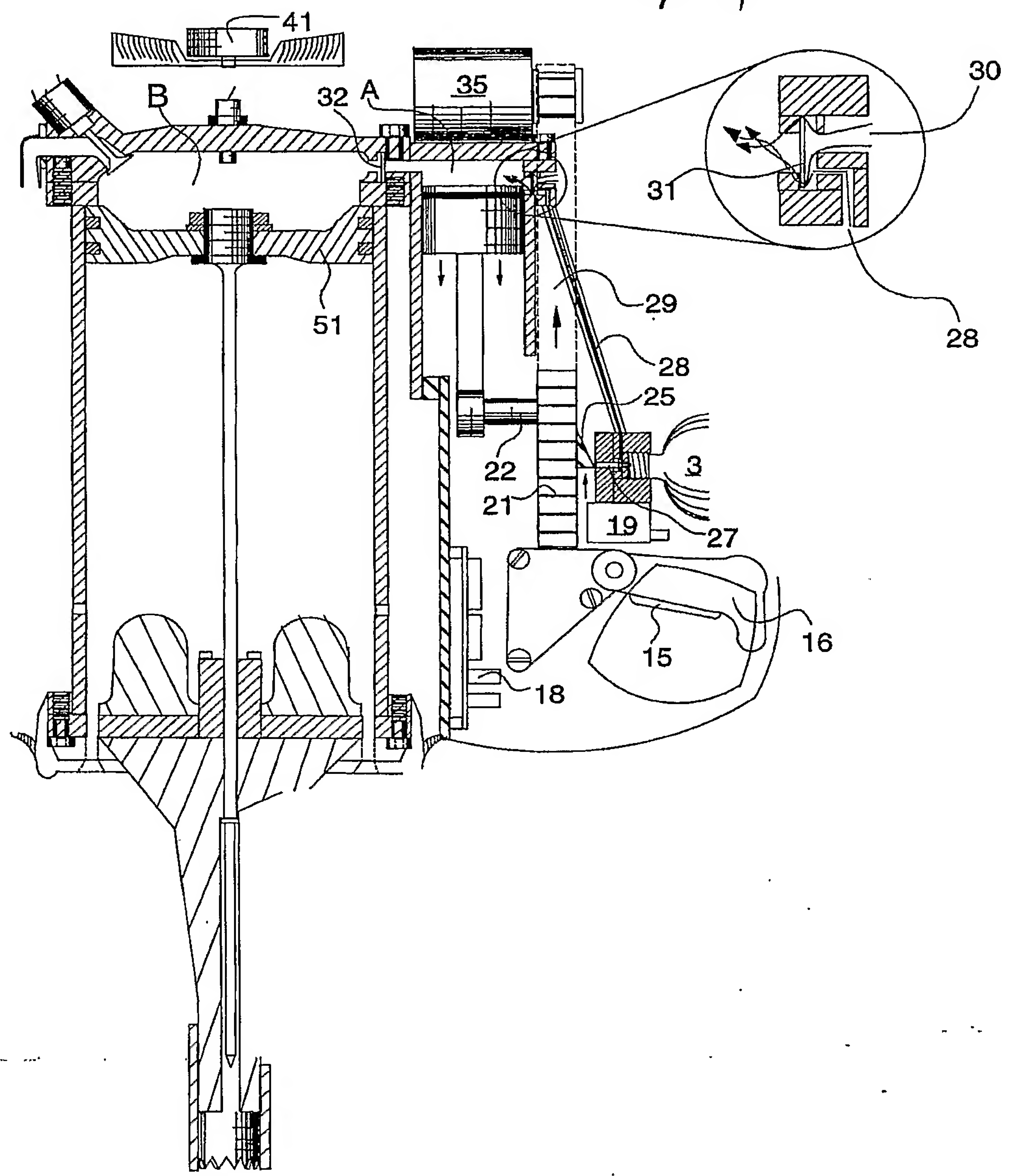
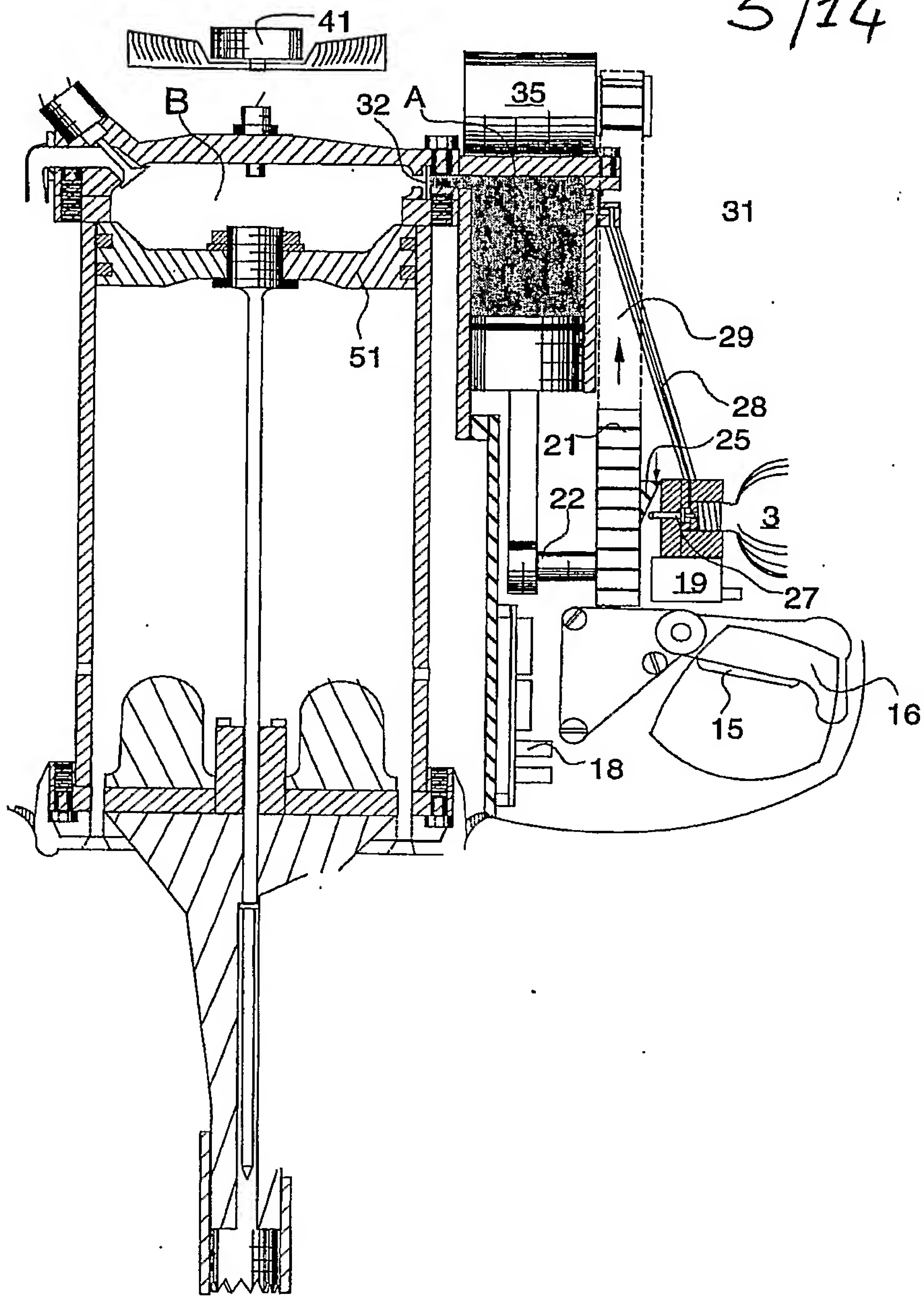


Fig. 5



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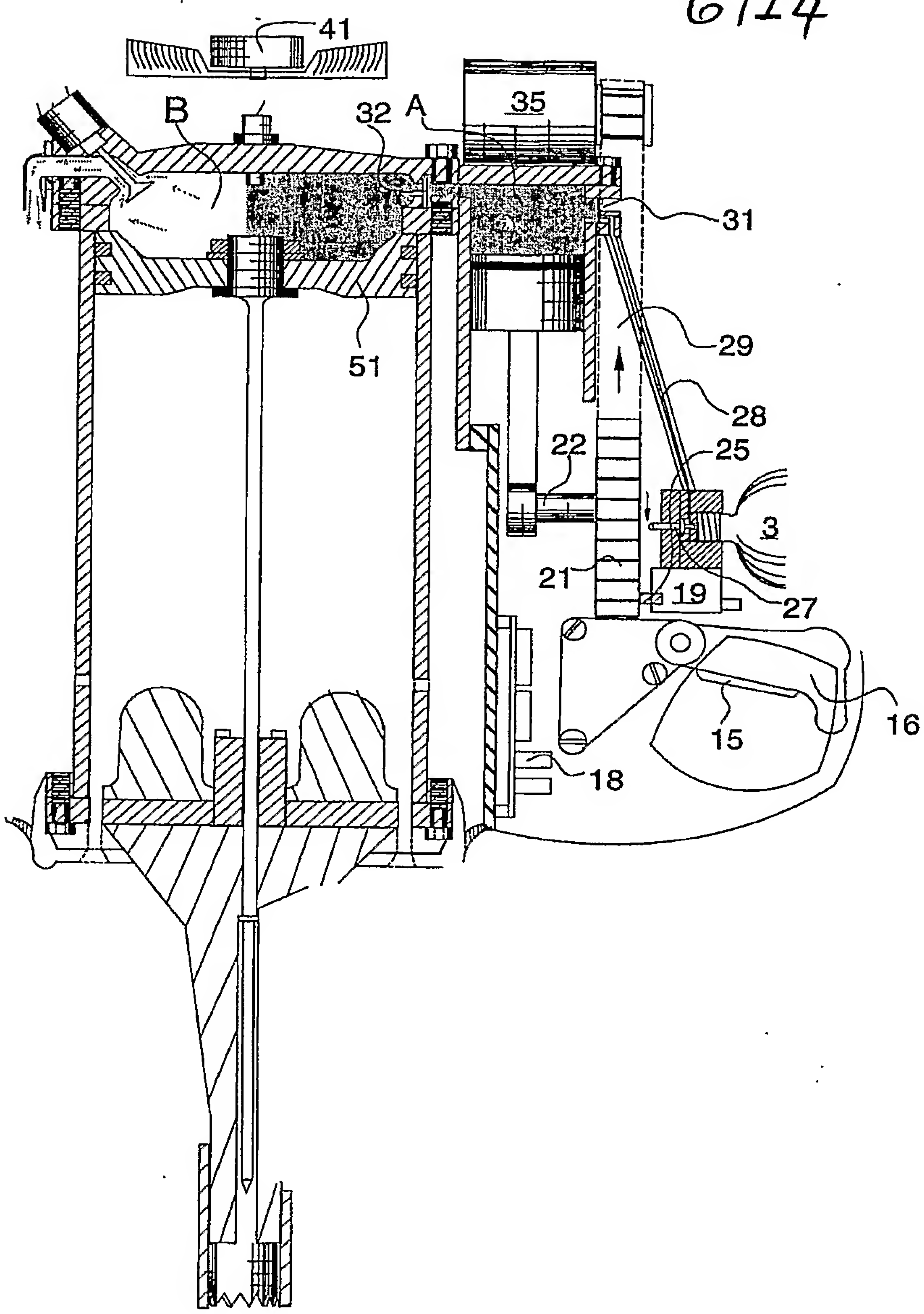

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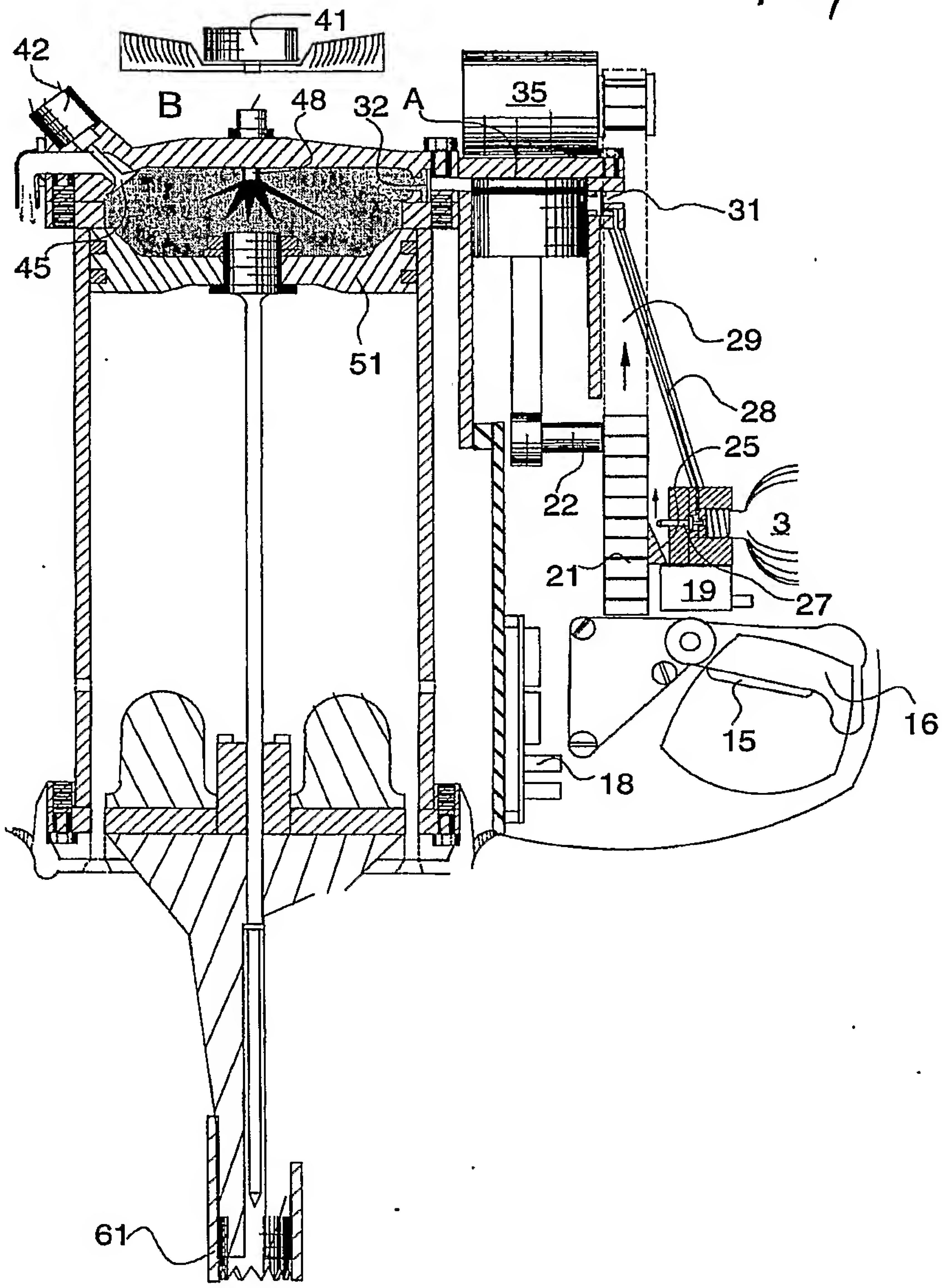

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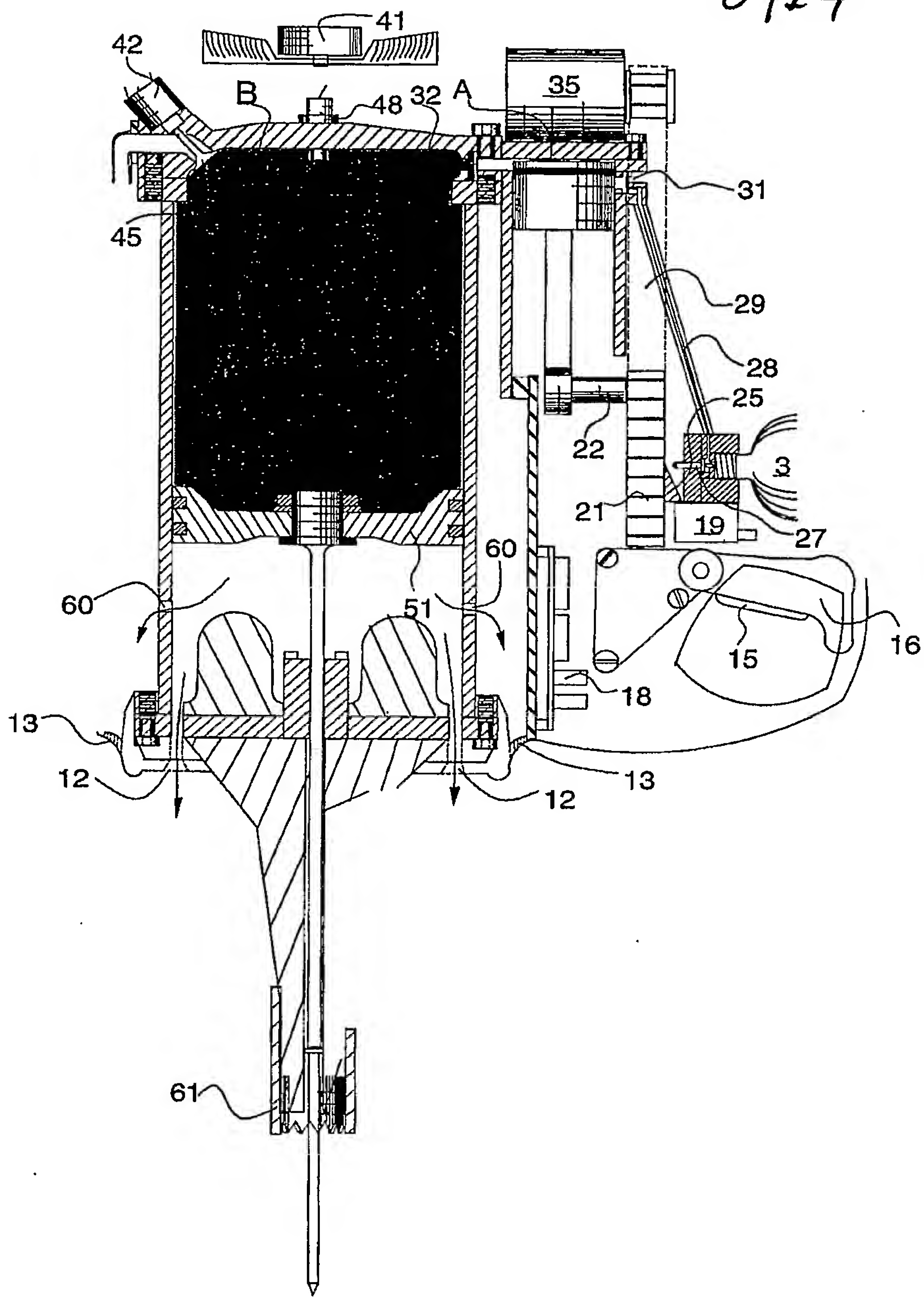
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FIG. 9

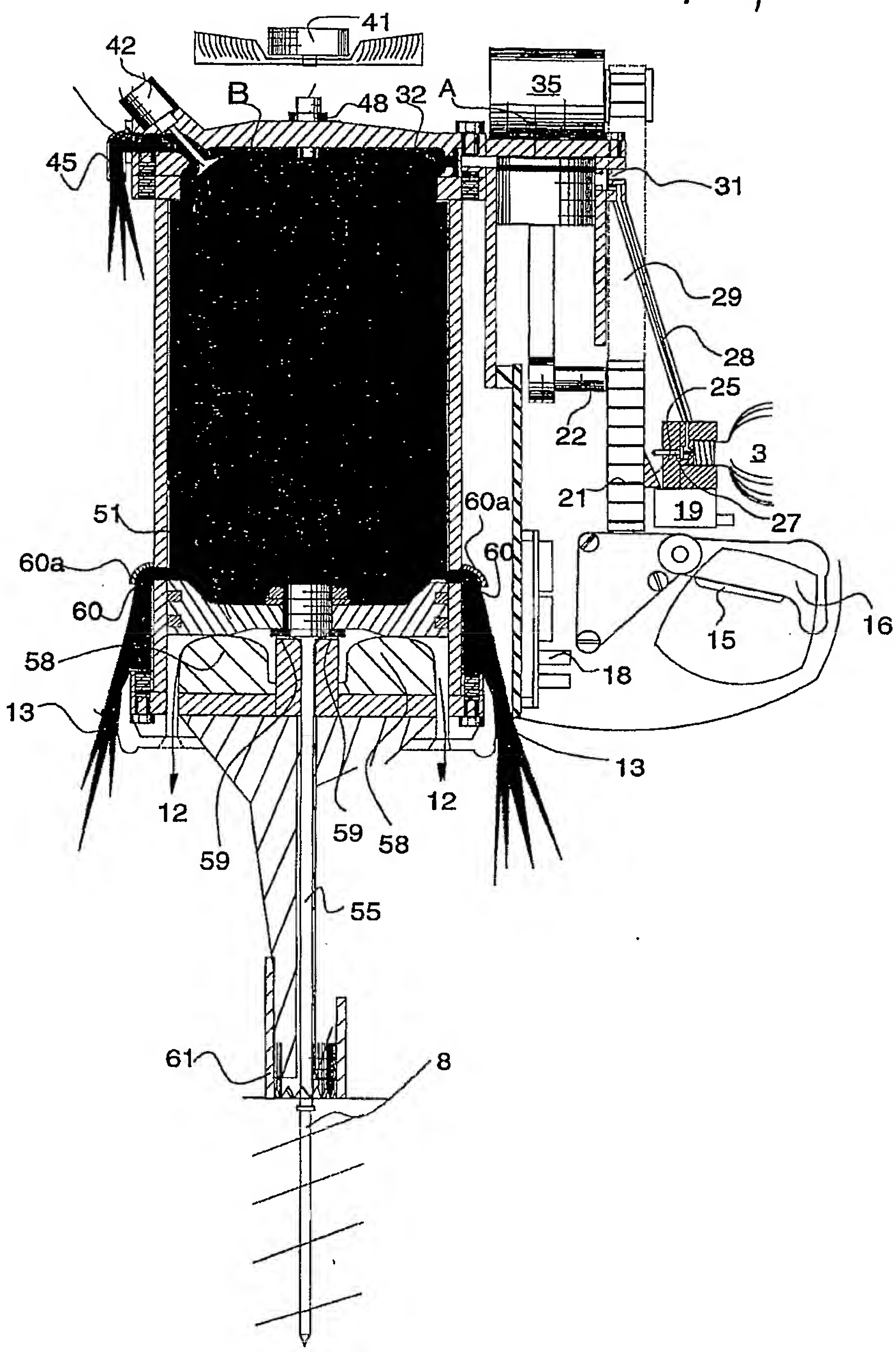
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FIG. 10

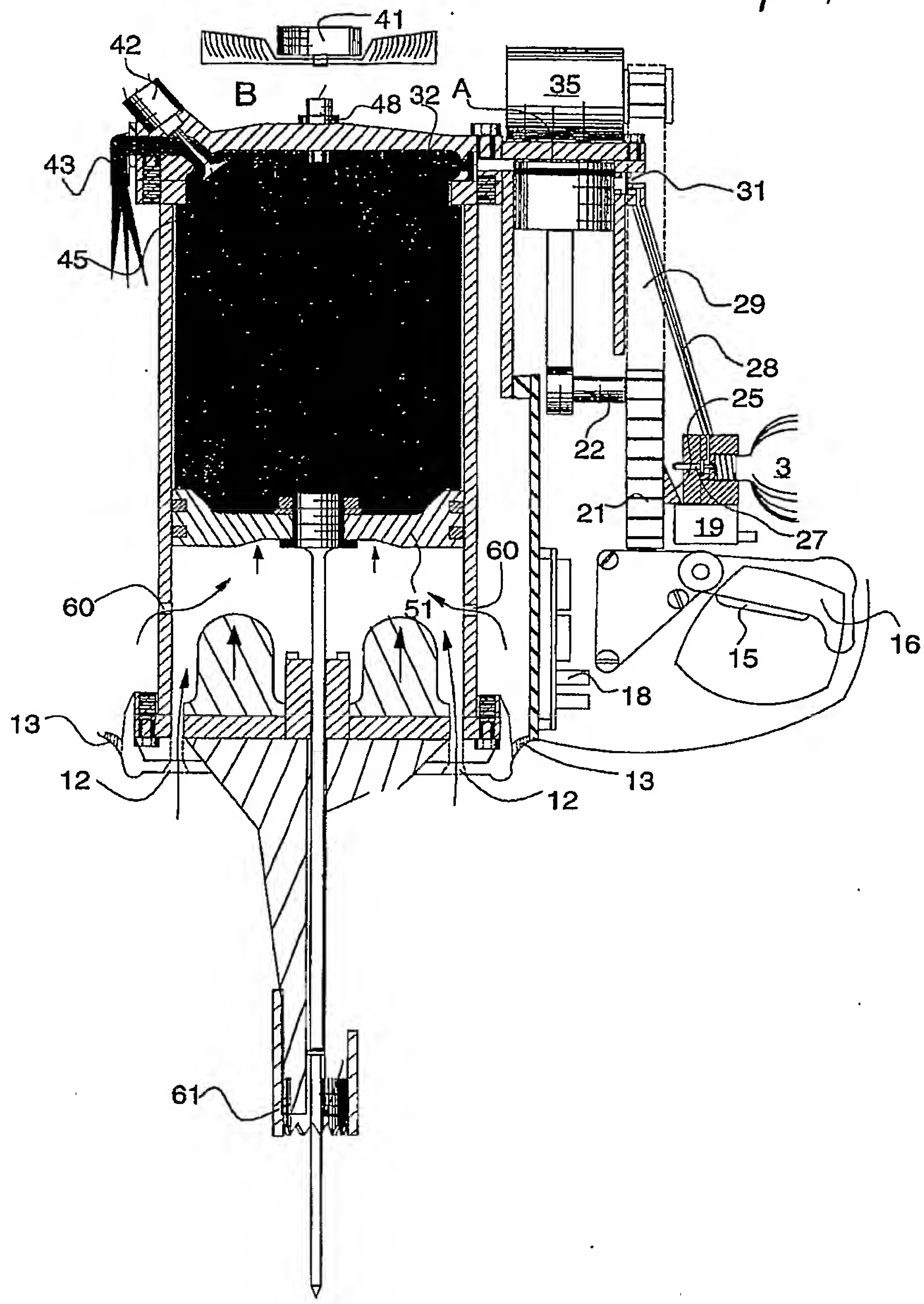
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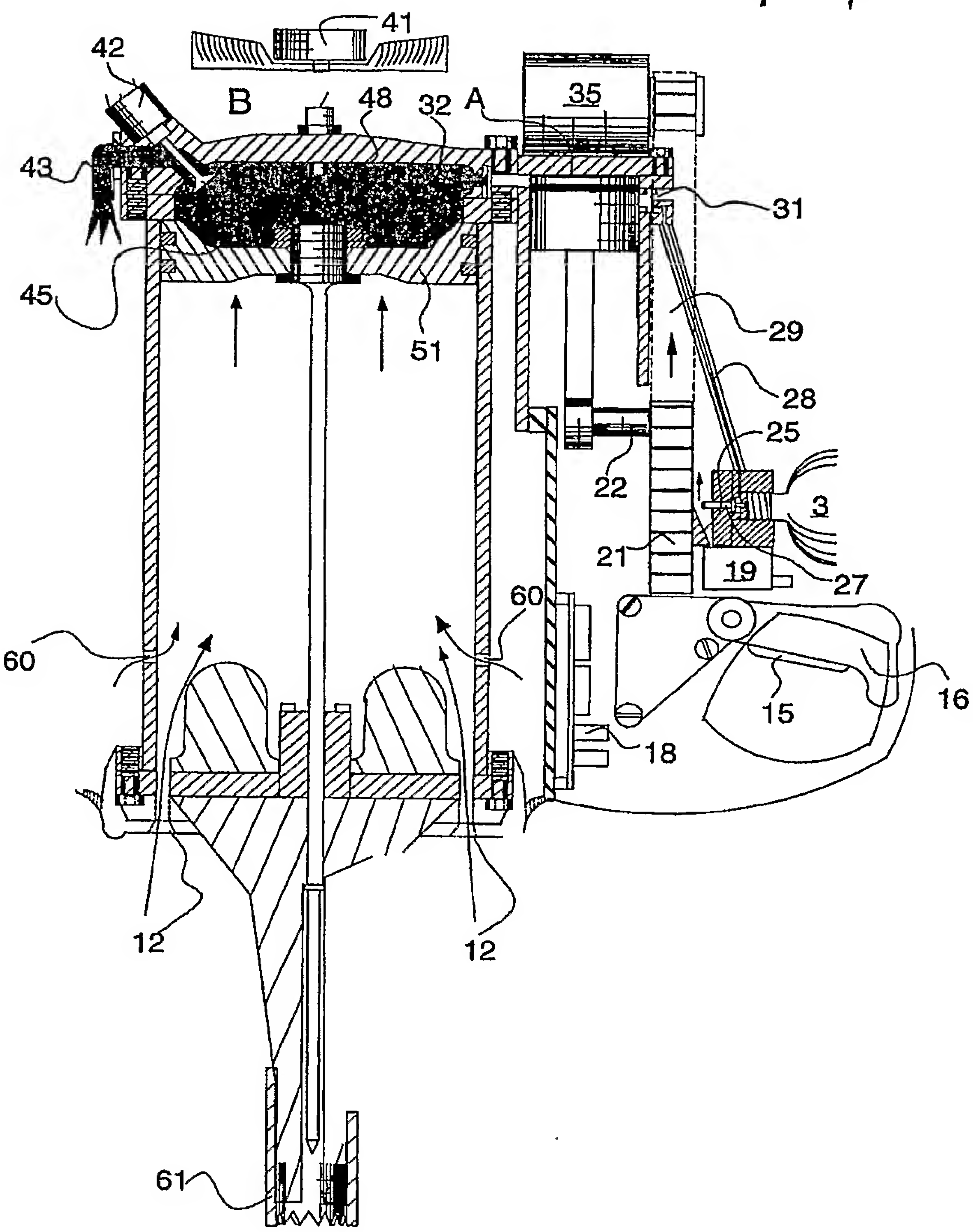
FIG. 11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F.G. 12

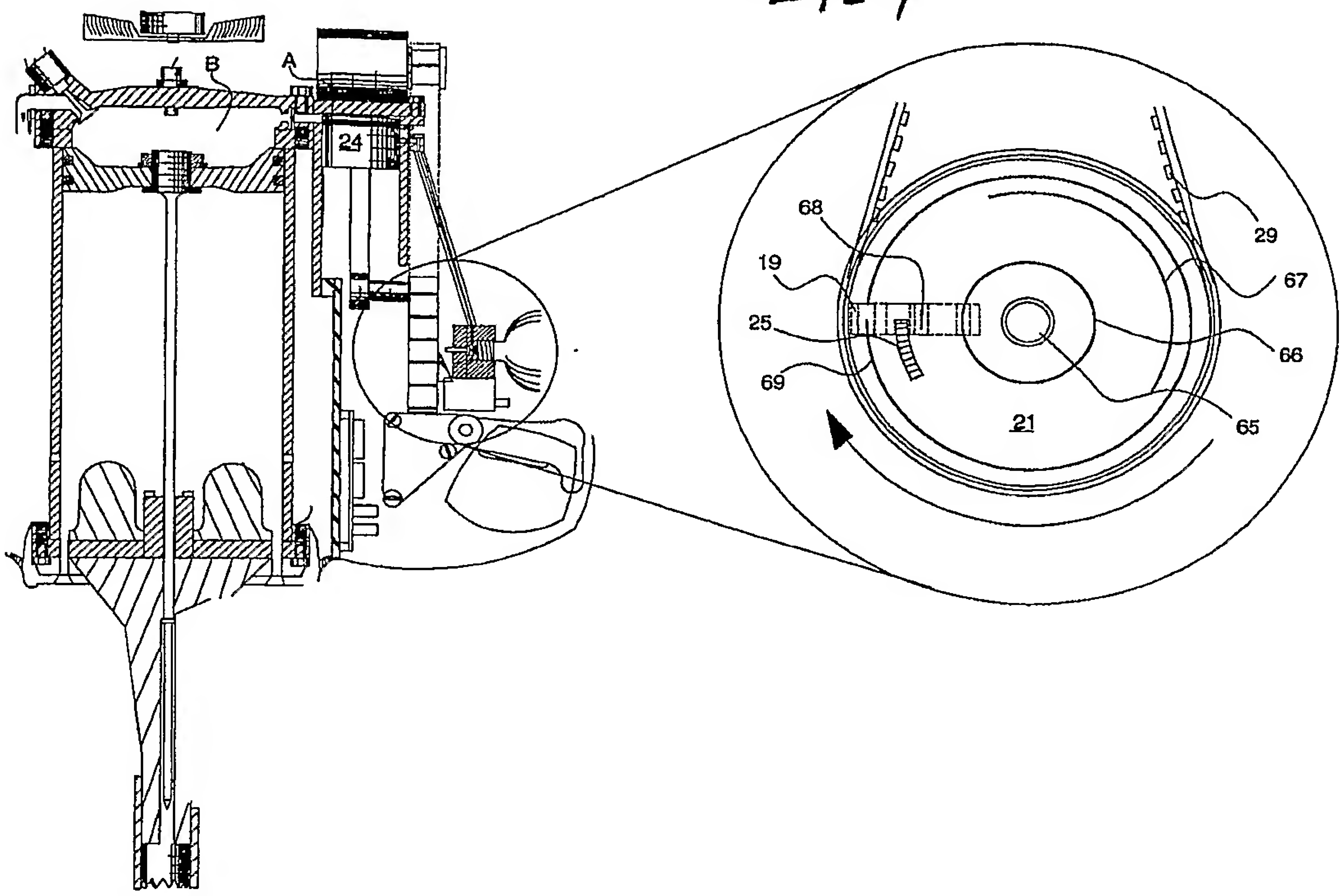

FIG. 13

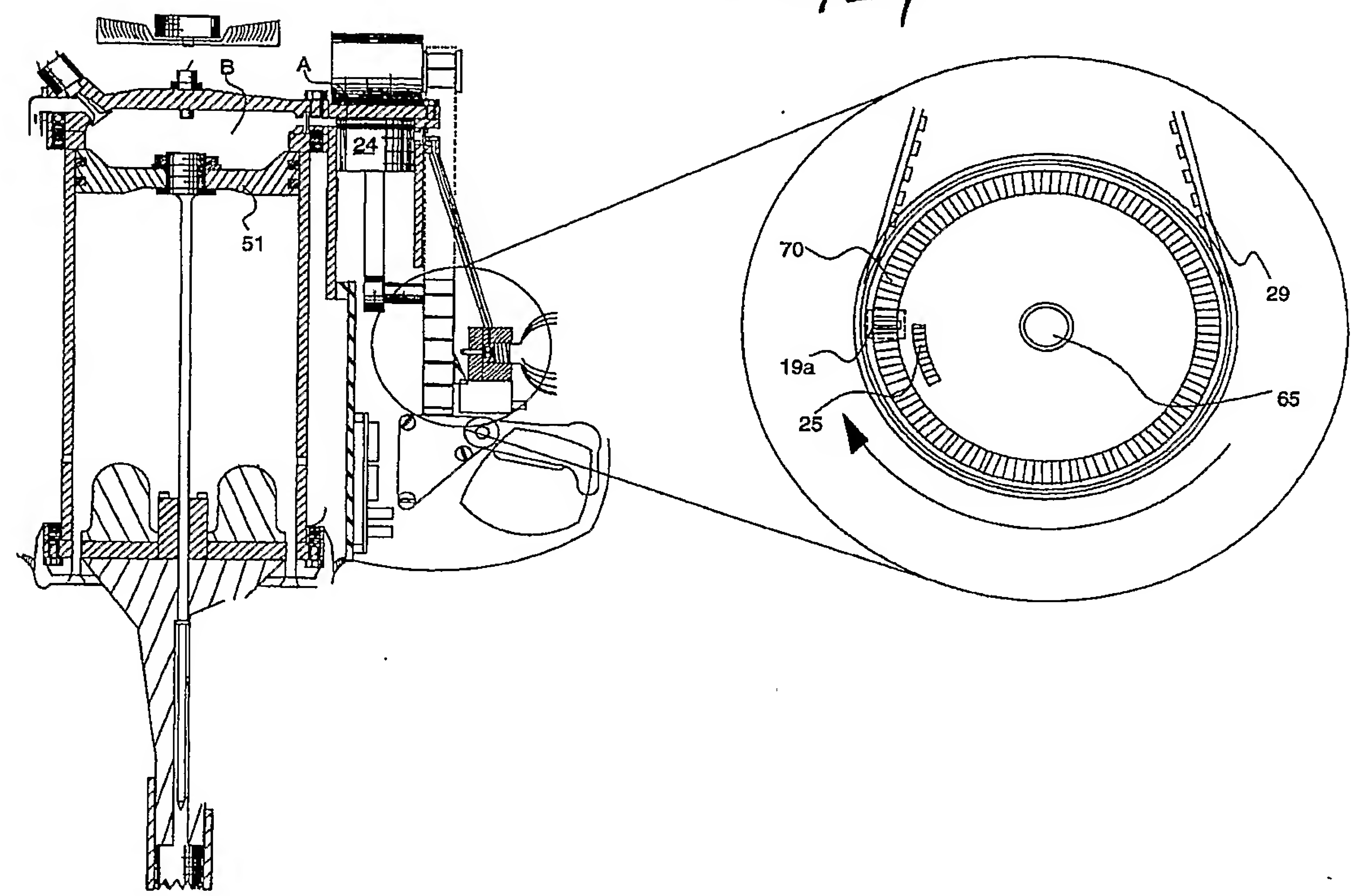

FIG. 14

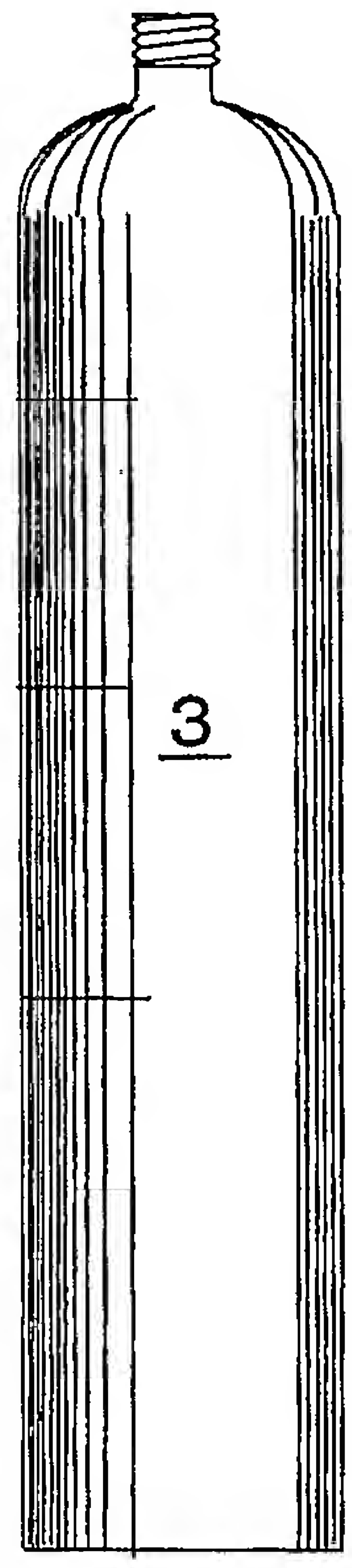

FIG. 15a

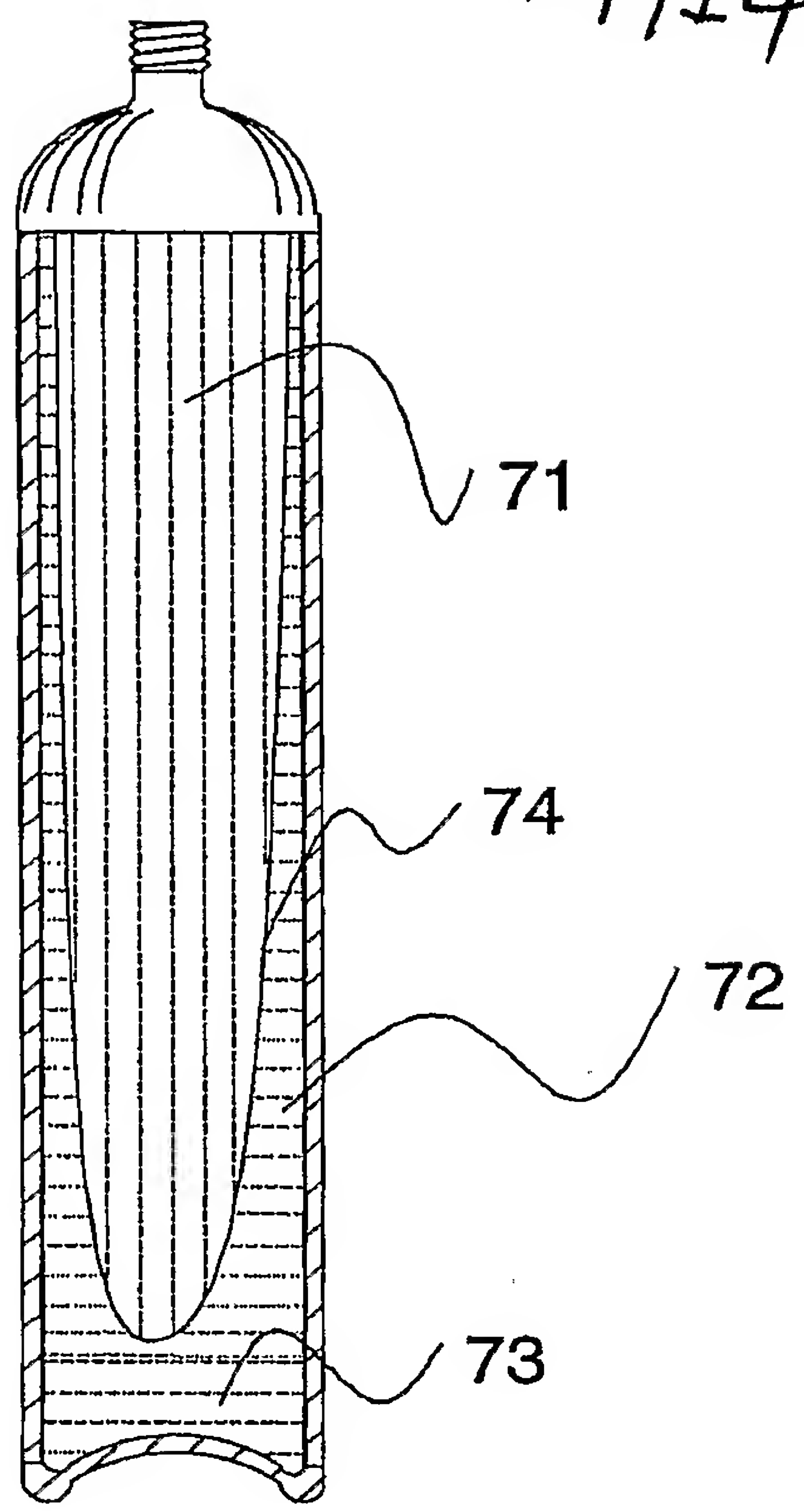

FIG. 15b